5-2021

Outpatient Physical Therapy Management of a Unilateral Total knee Arthroplasty: A Case Study

Kelsey Knutson

OUTPATIENT PHYSICAL THERAPY MANAGEMENT OF A UNILATERAL TOTAL KNEE ARTHROPLASTY: A CASE STUDY

by

Kelsey B Knutson
Bachelor of Science in Athletic Training
University of North Dakota, 2018

A Scholarly Project Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine and Health Sciences

University of North Dakota

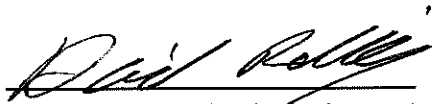
in partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy

Grand Forks, North Dakota
May
2021

This Scholarly Project, submitted by Kelsey B Knutson in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Graduate School Advisor)



(Chairperson, Physical Therapy)

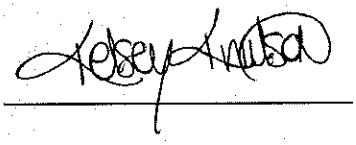
PERMISSION

Title Outpatient Physical Therapy Management of a Unilateral Total Knee Arthroplasty: A Case Study

Department Physical Therapy

Degree Doctor of Physical Therapy

In presenting this Scholarly Project in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the Department of Physical Therapy shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my work or, in his absence, by the Chairperson of the department. It is understood that any copying or publication or other use of this Scholarly Project or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in this Scholarly Project.

Signature 

Date October 4, 2020

TABLE OF CONTENTS

LIST OF FIGURES

Figure

LIST OF TABLES

Table

ACKNOWLEDGEMENTS

I would like to thank my clinical instructor Dr. Kim Givler, PT, DPT for the guidance throughout this case and allowing me to participate in this patient's care.

Another thanks is extended to my classmates for the peer reviews, suggestions, and advice along the way.

A final thank you to Dr. Mark Romanick, PT, PhD, ATC with whom this project would not have been possible without his direction and leadership!

ABSTRACT

BACKGROUND AND PURPOSE. Knee osteoarthritis is an increasingly prevalent diagnosis in the aging population and total knee arthroplasty is one of the most common treatment options in the advanced stages. The purpose of this article is to describe the interventions and results with an outpatient physical therapy program based on mobility and gait training.

CASE DESCRPTION. This case study focuses on the intervention and management of a total knee arthroplasty in a 78-year-old female over 8 weeks. She had a typical presentation of restricted range of motion, gait and proprioception deficits, and lower extremity weakness of the surgical limb.

INTERVENTIONS. The treatments were based off patient's limitations in range of motion, strength, abnormal gait patterns, and proprioception deficits. Interventions included balance training, gait training, manual therapy, and therapeutic exercises and activities. A large focus on this program was gait training drills to normalize gait pattern to return to prior level of function. Aquatic therapy was also utilized in this plan of care for a long-term exercise regime.

OUTCOMES. Following physical therapy intervention, the patient was able to normalize her gait pattern without the use of an assistive device, restore range of motion, and make functional strength gains to aid with independent ADL's. She was also able to establish an independent aquatic-based exercise routine.

DISCUSSION. All exercises were progressed as tolerated and in accordance with post-surgical protocol with success. Gait training, exercise, and aquatic therapy could have all been factors

contributing to her final functional level. Following physical therapy care episodes, the patient was able to return to prior level of function and increase overall quality of life.

Key words: total knee arthroplasty, knee pain, knee range of motion, gait training, manual therapy, aquatic therapy, neuromuscular reeducation, quality of life

CHAPTER I

BACKGROUND AND PURPOSE

Introduction and Literature Review

"Knee osteoarthritis is the most common type of arthritis diagnosed, and its prevalence will continue to increase as life expectancy and obesity rises."[1] Between 10 and 13% of men and women over 60 and 40% of adults over 70 have symptomatic knee osteoarthritis. Prevalence has been shown to be higher in females than males.[1]

The American Academy of Orthopaedic Surgeons reported 650 674 total knee arthroplasties were completed in 2018, which accounted for 55.9% of all hip and knee joint replacement surgeries.[2]

The literature supports rehabilitation based on range of motion, functional strength, gait training, and pain control with total knee arthroplasties.[3,4] The most important part is regaining full knee extension to aid with proper gait mechanics, but it is much harder to gain in the later stages of therapy. Studies have shown the earlier full extension is achieved the better outcome a patient will have. Incorporating neuromuscular reeducation of the quadriceps muscles is a vital role in extension, especially in conjunction with strengthening for improved function.[3,4] Research has shown good pain control results with the use of interferential current for postoperative knee pain and even edema reduction.[5] Aquatic therapy was utilized in the end of the plan of care at the patient's request to be able to continue an independent program after discharge.

The purpose of this case study is to express the outcome for a patient with a right total knee arthroplasty following outpatient physical therapy comprising gait training, neuromuscular reeducation, functional strengthening, and an independent aquatic-based exercise program.

CHAPTER II

CASE DESCRIPTION

History

This patient was a 78-year-old Caucasian female and retired nurse who was referred to physical therapy after a right total knee arthroplasty in the later part of 2019, due to long term degenerative changes from osteoarthritis. She reports there were no complications, but they corrected a valgus deformity during the surgery. She had a standard hospital stay and was discharged home with a front-wheeled walker and a postsurgical exercise program.

The patient felt her rehabilitation and home program were going well and reported some soreness in her thigh which she attributed to reducing the valgus angle and tourniquet used in surgery. Current pain at time of initial evaluation was a 3/10 on the numeric rating scale for pain. The patient reported being limited in most ADLs, as she could only stand or walk for 5 minutes, sit for 1 hour, and her daughter had been helping her out with all housework. She was able to complete bathing and dressing independently, but struggled to reach her feet, making it difficult to apply her compression stocking, socks, and shoes. The patient found activity would increase pain and symptoms in her knee, while ice typically helped control the pain and swelling. NSAIDs and Tylenol are the only medications she was taking for pain control at this time. Patients goals for physical therapy included taking care of herself when her daughter would leave the next week, defer a left total knee arthroplasty, and walk 1 mile.

She lived alone in a split level home and her daughter planned to return to her home in Spain the following week. Her hobbies included recreational walks, sewing, mahjong tiles at a local café, and baking. This patient had no previous history of hip or knee injuries but sustained a left ankle fracture with an open reduction and internal fixation (ORIF) in 2002 with no subsequent issues. She also reported osteoarthritis in her feet, ankles, wrists, and hands bilaterally and stated her hypertension was controlled with medication. The patient appeared to have no mental or cognitive deficits during initial evaluation.

She could possibly benefit from intervention given the decreased independence, inability to participate in leisure activities, postoperative status, and no hindering comorbidities found upon review.

Based on systems review and subjective history, we determined the patient was a good candidate for physical therapy in order to restore prior level of function and improve quality of life. Examination would reveal further information but was expected to be less invasive due to surgical referral.

Examination

Examination was based on Magee Orthopedic Physical Assessment 5th edition.[6] Initial examination was completed 2.5 weeks status postsurgery. The patient presented to physical therapy using a front-wheeled walker with a nonantalgic gait, limited in right knee flexion and terminal knee extension but had good symmetry in step length. When given a single point cane, she held it in the ipsilateral hand and ambulated with minimal reliance. Her incision was closed and healing well with several points of granular tissue present. There was moderate swelling in the right knee with considerable collection medially above her knee high compression stocking.

The patient used upper extremities to rise from a seated position and kept the right leg extended in front of her.

Proprioception and balance were assessed briefly, and single leg stance was poor bilaterally, see Table 1. She presented with mild tenderness to palpation around the right knee and lateral quadriceps. Patient's passive hip range of motion was within normal limits bilaterally with notably flexible hamstrings. Knee range of motion can be found in Table 2. Gross strength testing was completed in a sitting position with feet unsupported, please refer to Table 3 for results. No special tests were performed at this time due to acute postoperative status. She presented with a 69% disability based on her score of 31/100 on the Knee Injury and Osteoarthritis Outcome Score (KOOS) measurement. The deficits were comparable across all categories, with sports and recreation being the most impacted.

Table 1. Balance and Proprioception Assessment with Single Leg Stance at Initial Evaluation

Static Balance Assessment	**Right**	**Left**
Single Leg Stance	>3 seconds	>3 seconds

Table 2. Passive Range of Motion (in degrees) of the Knee at Initial Evaluation

PROM	**Right**	**Left**
Knee Flexion	78	130
Knee Extension	0 - 6	0

Table 3. Lower Extremity Gross Muscle Strength Screen at Initial Evaluation		
Gross Muscle Testing	**Right**	**Left**
Hip flexion	4/5	4/5
Knee extension	4/5	5/5
Knee flexion	4/5	5/5
Dorsiflexion	5/5	5/5
Plantarflexion	5/5	5/5

The single leg stance test was completed bilaterally on a short, low-pile carpeted floor with shoes on. The patient was instructed to place her hands on her hips and stand on one leg for as long as she could with her eyes open. This was attempted on each leg 3 times with the best score being recorded. Time was kept on a digital stopwatch with the starting point being lifting the opposite limb up and stopping as soon as it touched the floor.

Single leg stance does not have an established validity; however, the BC Physical Therapy Total Joint Arthroplasty and Outcome Measures Task Force has stated validity is not applicable.[7] It is intended to measure the static balance of an individual while standing on one foot. It was reported to have an excellent interrater reliability. Those unable to stand longer than 5 seconds are at an increased fall risk. There are normative values available for ages 18 to 99 and it is suggested a minimal clinical difference of 8.3 to 11.6 seconds is statistically significant in the reduction of falls. [7,8]

KOOS has been shown to be effective in evaluating knee injury patients through a wide age range with strong content and construct validity, internal consistency, and test retest

reliability.[9] In a comparison to the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), the KOOS was identified as having a greater validity in measuring functional limitations and abilities in patients with osteoarthritis.[10] It includes 5 subscales measuring pain, symptoms, ADLs, sports/recreation, and knee-related quality of life. These different subsets allow for a more accurate representation from a broad range of injuries through the lifespan from age 13 to 79. The higher the score, the less disability the patient is said to have, with a perfect score considered 100. There are no current sets of age-matched normative data, but improvement is based on score.[9,11]

Evaluation

After thorough subjective and objective review, the patient's main impairments are limited range of motion compared to the nonsurgical knee, overall decreased strength in the affected limb with deficits present in hip flexion bilaterally, and swelling and edema in the right knee. She was currently limited in her ability to stand, sit, or walk for extended periods of time which was likely affecting her ADLs. The combination of these has restricted her from participating in her grocery shopping, household chores, and recreational activities such as walking and sewing.

Goals for therapy are focused on returning range of motion, normalizing gait pattern without use of an assistive device, and functional strength to aid with transfers and stair ambulation. Short term goals were to increase right knee range of motion to 0 to120 degrees and ambulate independently without an assistive device for 250 ft on stable terrain. Both of these goals were to be met in 3 to 4 weeks to aid with safe ambulation in her home and the community. Long term goals were to increase patient's function and strength which were measured by ascending and descending a flight of stairs with a reciprocal pattern and use of a handrail and 10

sit to stands from a standard chair without use of upper extremities. These were to be met within 6 weeks, the time of projected discharge. A good prognosis was anticipated with this patient.

Diagnosis

Clinical impression and initial evaluation data support the suspected range of motion restrictions, strength deficits, and gait disturbances after a total knee arthroplasty. In accordance with ICD10 codes, the patient fit ICD10: M25.561: Pain in right knee and Z96.651: Presence of right artificial knee joint. These components contribute to her limited ability to stand or walk for longer than 5 minutes as well as complete ADLs independently. This patient was appropriate for skilled physical therapy in order to restore function and quality of life.

Prognosis and Plan of Care

The patient was expected to make good progress with a physical therapy program focused on mobility based on her motivation and compliance with her current home exercise program from her surgeon. She demonstrated good intentions to improve and was likely to make progress with her availability for a high frequency plan. A 2008 study had shown the biggest functional improvements are made in the first 12 weeks with a slower continued progression up to 26 weeks. [12] This was essential in identifying rehabilitation goals for an ideal prognosis in postoperative patients.

Recertification

The patient was re-evaluated every tenth visit for a progress note in accordance with Medicare guidelines. When the patient had reached the end of her original 6 week plan of care, she believed she had not hit her ceiling in terms of therapeutic benefits. In order to help prevent a left total knee arthroplasty, she would have to continue with an independent exercise program. Prior to her surgery, she was completing an aquatic-based program a few times weekly and

would like to return to that routine. A recertification for 2 weeks was established for her to focus on developing an individual routine to complete after discharge. This program was based partially off a previous regimen she had and focuses mainly on lower extremity and core strength.

CHAPTER III

INTERVENTION

The goal was to restore degenerated knee biomechanics surgically and regain function through rehabilitation following surgery.[13] Research has shown lower extremity strengthening focused on quadriceps[14] and the hip complex[15,16,17] is essential in restoring prior level of function in patients following a total knee arthroplasty. Neuromuscular reeducation and balance training have shown to be significantly beneficial in recovering function and restoring mobility in patients with a total knee arthroplasty due to degenerative changes of osteoarthrosis.[18]

The patient was seen in physical therapy over 8 weeks for a total of 20 visits. The initial plan of care was 3 times weekly for 6 weeks and consisted of therapeutic exercises, therapeutic activity, gait training, neuromuscular rehabilitation, manual therapy, and electrical stimulation. One of the patient's goals was to prevent a left total knee arthroplasty through implementation of an aquatic exercise routine. Studies have shown aquatic exercise including stretching, strengthening, and aerobic training provided a moderate increase in physical function as compared to nonexercise in those with knee osteoarthritis.[19]

Interventions and treatments were based on patient's limitations in range of motion, strength, abnormal gait patterns, and proprioception deficits and congruent with postoperative protocol from her surgeon. A large focus on this program was gait training drills to normalize gait pattern to return to prior level of function. An additional 2 weeks at 1 time weekly was granted through recertification after her original plan and focused solely on creating a long term

aquatic therapy exercise regime. A detailed outline of the Plan of Care can be found in Figure 1 in the Appendix. Progress notes were completed every 10th visit along with one recertification plan in which both were sent and signed by her physician. Updates were also sent to her surgeon prior to her routine checkups.

After the initial examination and evaluation, the patient was informed of the diagnosis and prognosis and included in creation of treatment goals. She was educated on the process, healing time frames, anatomy of involved structures (using a knee model), incision care, edema and pain control, and importance of participation and compliance with her program. The patient was a retired nurse and, therefore, was available for a high frequency plan and had a good understanding of wound management and infection control.

Home Exercise Program

The patient was given an extensive home exercise program for postoperative total knee arthroplasty from her surgeon following the procedure in which she reported included both stretching and strengthening exercises. A large portion focused on regaining quadricep control which was critical for long term and functional recovery.[14] Due to her high frequency plan, this was utilized throughout her time during physical therapy. After she was status post 4 weeks, some exercises were progressed and added as appropriate. The patient was involved in the creating of her aquatic therapy program which focused on lower extremity and core strengthening for a continued maintenance plan.

Manual Therapy

Manual therapy was utilized during the first 6 weeks of her treatment plan with a focus of effleurage to help will edema control as well as tibiofemoral joint mobilizations to improve flexion and extension. In order to restore mechanics appropriately, knee extension was crucial

and joint mobilization help promote proper joint arthrokinematics and increase capsular extensibility.[20]

An anterior glide was performed using a wedge to block the tibia with an anterior to posterior force on the distal femur at a grade 3 and 4 for improved extension. A posterior glide for improved flexion was completed with the wedge blocking the femur and an anterior to posterior force on the proximal tibia at a grade 3 and 4. These mobilizations were completed with 1 to 2 seconds on and 1 to 2 seconds off for 4 minutes each. All manual therapy was completed in a supine position with the knee in open pack position of 25 degrees flexion.

Therapeutic Exercises and Activity

The patient would use a NuStep (recumbent cross trainer, manufactured by NuStep in Ann Arbor Michigan) as a warmup during the first 3 weeks of physical therapy. When she demonstrated 110 degrees of knee flexion, she began to use the recumbent bike up to 10 minutes for improved range of motion and a warmup from week 3 to 6.

After manual therapy was completed, heel slides were completed with slight overpressure to end range knee flexion during weeks 1 to 2. These first 2 weeks consisted of strength building exercises consisting of hamstring curls on a physioball, supine bridges with an isometric hold at the top, resisted terminal knee extension with a medium resistance band, and total gym double leg squats. The total gym used was a "Power Tower" set at the highest level.

Weeks 3 and 4 consisted of progressions of the previous strength-based exercises with the addition of a few new ones. Bridges were completed with both feet on a physioball and the next level of resistance band was used for the terminal knee extensions. New exercises included total gym single (surgical) leg squats on highest setting and single leg stance completed bilaterally.

Weeks 5 and 6 incorporated new exercises with those previously listed. Sit to stands from a standard 18-in chair with verbal cues for equal weight distribution and correct form were needed. Sit to stands are a functional strengthening task which aid in safe and independent transfers. Cueing for equal weight distribution allows for the patient to load the operational limb to allow for more angular velocity which was an essential component in building momentum to rise from a seated position.[21] Monster walks (forward facing diagonal stepping pattern) with a medium resistance band around the ankles were also added into her program for a hip strengthening and balance component. To further challenge balance, single leg stances were completed on an Airex pad (manufactured by Airex in Switzerland) and single leg 6-in step ups to a single leg stance hold were integrated bilaterally. See Figure 1 in Appendix for specifics.

Gait Training

The patient completed a series of gait drills throughout the entire 6 weeks of land-based sessions. Studies have concluded gait pattern two years post total knee arthroplasties can result in residual disabilities if it is not addressed in an early phase.[4] There are typically abnormalities with kinematics and kinetics during the load accepting phases and result in muscle co-contractions and ultimately altering the normal gait pattern during rehabilitation. Items included in this series were not performed in a specific order but randomized to promote active learning and muscle reeducation. Each therapy session consisted of high knee marching, butt kick walking, tip toe walking, heel walking, tandem walking, backward walking, side steps, and carioca walking. Volume was increased throughout the sessions to patient tolerance. See Figure 1 in Appendix for specifics. Starting at week 4, 6-in hurdles were incorporated into the gait drills. She was to step over each hurdle using a reciprocal gait pattern and encouraged to look up and not at her feet. Moderate verbal cues were needed throughout the gait training for proper

mechanics. All of these gait drills were completed with standby assist for the patient's safety as there was no assistive device used.

Electrical Stimulation

The patient received 15 minutes of interferential current (IFC) to her tolerated threshold with an icepack to surgical knee for pain and swelling control. She was in supine with a bolster under both legs to elevate them above the heart. Pads used were 2x2 and applied to the knee in an "X" pattern. This was done after each session for duration of the land appointments.

Aquatic Therapy

Weeks 7 and 8 consisted solely of developing an aquatic-based program for her to complete independently. Exercise is important for the management of osteoarthritis; and aquatic exercises were shown to show significant improvements in hip and knee flexibility, strength, and overall aerobic fitness. It has been suggested there are short term benefits with minimal adverse effects; however, there was no self-reported pain or functional improvements.[22] This program was based partially off a previous regimen she had and focuses on lower extremity and core strength. Warm up consisted of forward walking, backward walking, side steps, and walking carioca laps. Lower extremity strengthening exercises consisted of standing 3-way hip (flexion, abduction, and extension), noodle single leg press, single leg 6-in step ups completed bilaterally, aquatic squats, standing marches, and hip circles. Core stabilization exercises included a kickboard in which the patient would do a push and pull motion, push down motion, and a side-to-side motion while keeping core engaged and trunk stable. She would then end her workout with deep water bicycle kicks with a noodle for support. Aside from the warmup laps and deep water cardio, the sequence of exercises was irrelevant. See Figure 1 in Appendix for specifics.

Other Interventions

There are various interventions to be utilized in the recovery of a total knee arthroplasty tailorable to each patient. These include, but are not limited to biofeedback[23,24] or neuromuscular electrical stimulation[25] for muscle activity, kinesiotaping[26] for edema control, and other manual therapy techniques such as soft tissue manual therapy for scar mobilization and patellar mobilizations.[27] Treatments should be individualized for the patient's needs based on their current status, presentation, and other comorbidities.

CHAPTER IV

OUTCOMES

The patient was seen three times weekly for 6 weeks with 60 minutes sessions, and once weekly for an hour in the remaining 2 weeks with a focus on aquatic therapy. She was discharged from physical therapy based on meeting her personal goals, as well as objective goals showing improvements. This patient's compliance was exceptional, holding to a high frequency plan of care, adherence to HEP, and displayed a good attitude and motivation during sessions. It seems she was extremely satisfied and grateful for the progress she made with the ability to return to prior level of function and start an independent exercise regime following discharge.

At time of discharge, the patient was re-examined to determine level of improvements. Her final knee injury and osteoarthritis outcome score was a 67/100 and a 33% disability which was more than reasonable given the improvement from initial score of 31/100 at 69% disability. There are minimal detectable changes for each subcategory within the KOOS, but the overall minimal clinically important change is suggested to be 8 to 10 point increase.[11] The patient reported with a 36 point increase with sports and recreation category being the most limiting factors, which was to be expected given her age.

Static balance, range of motion, strength gains can be seen in Table 4, Table 5, and Table 6 respectively, which correlate to the objective goals of increasing right knee range of motion and increasing functional strength. She was able to perform normalized gait pattern without use

of an assistive device, ascend and descend a flight of stairs using a reciprocal gait pattern with minimal reliance of handrail, and 10 sit to stands without use of upper extremities or momentum.

Table 4. Balance and Proprioception Assessment with Single Leg Stance at Discharge

Static Balance Assessment	**Right**	**Left**
Single Leg Stance	15 seconds	18 seconds

Table 5. Passive Range of Motion (in degrees) of the Knee at Discharge

PROM	**Right**	**Left**
Knee Flexion	123	130
Knee Extension	0	0

Table 6. Lower Extremity Gross Muscle Strength Screen at Discharge

Gross Muscle Testing	**Right**	**Left**
Hip flexion	5/5	5/5
Knee extension	5/5	5/5
Knee flexion	5/5	5/5
Dorsiflexion	5/5	5/5
Plantarflexion	5/5	5/5

Due to the patient having completed an aquatic-based exercise program in the past, she was able to establish a new routine fairly quickly. The patient was educated on identifying any adverse reactions to the exercise and was informed to contact the surgeon or physical therapist

with any questions. There were no activity restrictions implemented from her surgeon at this time, so activities were based on patient's tolerance. Based on the improvements she was able to demonstrate and the ability to complete an aquatic-based exercise program independently, the patient was discharged from physical therapy.

CHAPTER V

DISCUSSION

Osteoarthritis is becoming increasingly common across the world. Common treatments currently include patient education, lifestyle modifications, pharmaceutical interventions, exercise regimens, and ultimately total knee arthroplasty.[1,27]

According to Skou et al,[28] patients who received a total knee arthroplasty find better results in terms of pain and overall function compared to those who received a conservative nonsurgical treatment plan. Some of the participants who were treated with a non-surgical plan were able to delay surgery for up to 2 years. Overall, total knee arthroplasty is shown to be an effective option for patients suffering from knee osteoarthritis.

Ciolac et al[29] conducted a study comparing the effects of resistance training in older women with knee osteoarthritis and a total knee arthroplasty to younger and older women without any other musculoskeletal diseases. The study looked at functional performance, lower limb loading distribution, and balance. Results showed a global improvement in all groups, but a more significant increase in the total knee arthroplasty and osteoarthritis group of women. The study suggests resistance training is an effective intervention in restoring functional performance, balance, and equal load distribution in the legs. Bade and Stevens-Lapsley[30] found a high intensity program for rehabilitation after a total knee arthroplasty resulted in improved functional performance along with short and long term strength compared to a lower intensity program.

In comparison to the literature, this patient responded well to treatment during her plan of care focused on mobility. She demonstrated great progress by meeting all goals set at time of initial evaluation including restoration of right knee range of motion, functional strength, and independence with ADL's. Throughout the course of treatment, manual therapy was important for edema control and end range flexion and extension, while repetitive gait drills were instituted to increase dynamic balance and normative gait pattern. The patient wished to return to her previous regimen of aquatic-based exercise and wanted a review of appropriate exercise to complete. She had two sessions in the therapeutic pool and was able to narrow down an independent program she felt comfortable with completing. This patient's motivation and compliance with her exercises program may have contributed to her success with physical therapy.

Along with functional outcomes, another component to consider is quality of life. The majority of prognostic factors incorporate measurements of quality of life. According to Canovas,[31] patients who have undergone total knee arthroplasties often report satisfaction due to increased quality of life through decreased pain and increased abilities and function. However, literature reports up to 30% of dissatisfied patients who deem their results insufficient from underlying sources including social, psychological, and behavioral factors. They looked at various components to which can attribute to quality, such as range of motion, surgical techniques, comorbidities and other patient factors, and patient expectations. Results found an inverse correlation between pain and function with quality of life.

Study Limitations

Various limitations were presented during this case including no follow up post discharge, no access to medical records beyond referral, and limited information collected by

author prior to writing the case report. Without access to medical records or physical therapy notes, information was based on recall and notes taken on the patient and her treatment. The outcomes are not generalizable to the public as this patient is not a representative sample of the population and results are not contingent of the plan of care.

Reflective Practice

The course of treatment was shown to be successful in the outcomes and even though the patient, myself, and my clinical instructor were all pleased with the results, there are aspects of the care in which could have been different. I was present during the initial examination and was able to complete some components, while my clinical instructor was the one who performed the assessment and subsequent note. I believe this was conducted well and all procedures chosen were appropriate for the patient. I attribute this to previous episodes of care my clinical instructor had with this patient as well as her competence in the field.

Reflecting back on this patient's care and throughout the various research for this case study, I have learned many things to help future patients. In addition to the questions already asked in the initial examination, there are a few subjective questions I would have further evaluated. These include the past medical history of her ankle ORIF in 2002 and how well her blood pressure was controlled as hypertension was only reported on her intake form and not reviewed verbally during the initial evaluation. I would have also liked to have the surgical report being a new student in the clinic. Knowing support is a key factor in any recovery, I would have asked more questions to follow up on after her daughter left, as she lives alone. In terms of examination procedures, I would have measured range of motion in the hip with a goniometer, taken circumferential measurements for edema markers, and incorporated other functional tests such as the timed up and go (TUG), 6-minute walk test, and dynamic gait index or functional

gait assessment. These would have allowed me to better assess and compare outcomes with progressions as well as to literature findings.

Based on the objective measures, it seems the patient had a successful plan of care but there are a few things in which could have increased the potential. The biggest tool I wish I had incorporated was the BodiTrak Vector Force Plate (manufactured by BodiTrak in Canada). I was not aware I had access to this until my last week in the clinic and would have liked to use it for biofeedback of weight distribution training. I had discussed other treatment options previously including neuromuscular training for quadriceps and kinesiotaping for edema which could have also been utilized here along with other manual therapy techniques. I would have also taken more measurements throughout the case to better track specific progress with pain management, edema, and range of motion. Lastly, I would have gotten a copy of the surgeon's postoperative protocol for her home exercises program to better progress her with those exercises.

During the process of writing and researching, I found myself struggling to find any evidence or research specific to manual therapy joint mobilizations for improved range of motion following total knee arthroplasty. This was an intervention chosen by my clinical instructor based on her clinical knowledge and previous successes; based on my knowledge and education, it was a logical intervention for improvements in capsular extensibility.

There are no other disciplines I would have referred to or sought out for this patient. I believe this patient was well managed in physical therapy between my clinical instructor and me. For future references, I would like to keep an open line of communication with the surgeon if problems, questions, or concerns were to arise.

Conclusion

The patient chose to have a total knee arthroplasty to resolve advanced osteoarthritis in her right knee and had positive outcomes as she recovered and engaged with physical therapy rehabilitation. This case report discussed the use of therapeutic exercises and activities, neuromuscular reeducation, manual therapy, and gait training to restore prior level of function. This patient was able to regain range of motion within functional limits, normalizing gait pattern without use of an assistive device, and increased functional strength to aid with transfers and stair ambulation. She was also able to establish an independent aquatic exercise regime to routinely follow after discharge for maintenance. Results are comparable to literature cited throughout the case report.

APPENDIX

Figure 1.
Detailed Plan of Care

Week 1 and 2	
Therapeutic Exercise and Activity	
- NuStep for range of motion and muscle activation	10 minutes
- Heel slides with overpressure at end range *Performed after manual therapy	1x15
- Supine hamstring curls on physio ball	2x10
- Supine bridge with isometric hold	2x15 with 3 second hold
- Resisted terminal knee extension	2x25 with medium resistance band
- Total gym (Power Tower) double leg squat	2x10 at highest setting
Manual Therapy	
- Effleurage for edema control	5 minutes
- Anterior tibiofemoral glide for extension	4 minutes; grades 3 and 4
- Posterior tibiofemoral glide for flexion	4 minutes; grades 3 and 4
Neuromuscular Reeducation and Gait Training	
- High knee marching	2x20 feet
- Butt kick walking	2x20 feet
- Tip toe walking	2x20 feet
- Heel walking	2x20 feet
- Tandem walking	2x20 feet
- Backwards walking	2x20 feet
- Sidestepping	2x20 feet; bilaterally
- Carioca/grapevine	2x20 feet; bilaterally
Electrical Stimulation	
- IFC with cryotherapy (ice pack) legs elevated	15 minutes

Week 3 and 4	
Therapeutic Exercise and Activity	
- Recumbent bike for range of motion	10 minutes
- Supine hamstring curls on physio ball	2x20
- Physio ball bridge with isometric hold	2x15 with 3 second hold
- Resisted terminal knee extension	2x25; heavy resistance band
- Total gym (Power Tower) double leg squat	2x20 at highest setting
- Total gym (Power Tower) single leg squat	2x10 at highest setting
Manual Therapy	
- Effleurage for edema control	5 minutes
- Anterior tibiofemoral glide for extension	4 minutes; grades 3 and 4
- Posterior tibiofemoral glide for flexion	4 minutes; grades 3 and 4
Neuromuscular Reeducation and Gait Training	
- High knee marching	4x20 feet

- Butt kick walking | 4x20 feet
- Tip toe walking | 4x20 feet
- Heel walking | 4x20 feet
- Tandem walking | 4x20 feet
- Backwards walking | 4x20 feet
- Sidestepping | 4x20 feet; bilaterally
- Carioca/grapevine | 4x20 feet; bilaterally
- Reciprocal stepping over 6 in hurdles | 6x10 feet; week 4
- Single leg stance | 3x30 seconds; bilaterally

Electrical Stimulation

- IFC with cryotherapy (ice pack) legs elevated | 15 minutes

Week 5 and 6

Therapeutic Exercise and Activity

- Recumbent bike for range of motion | 10 minutes
- Supine hamstring curls on physio ball | 2x20
- Physio ball bridge with isometric hold | 2x15 with 3 second hold
- Resisted terminal knee extension | 2x25 with heavy resistance band
- Total gym (Power Tower) double leg squat | 2x20 at highest setting
- Total gym (Power Tower) single leg squat | 2x10 at highest setting
- Sit to stand from 18 inch chair | 2x10 week 5; 2x15 week 6
  *Verbal cueing needed
- Bilateral single leg 6 inch step up | 2x10 week 5; 2x15 week 6
- Monster walks with band around ankles | 4x20 feet; medium resistance band

Manual Therapy

- Anterior tibiofemoral glide for extension | 4 minutes; grades 3 and 4
- Posterior tibiofemoral glide for flexion | 4 minutes; grades 3 and 4

Neuromuscular Reeducation and Gait Training

- High knee marching | 6x20 feet
- Butt kick walking | 6x20 feet
- Tip toe walking | 6x20 feet
- Heel walking | 6x20 feet
- Tandem walking | 6x20 feet
- Backwards walking | 6x20 feet
- Sidestepping | 6x20 feet; bilaterally
- Carioca/grapevine | 6x20 feet; bilaterally
- Reciprocal stepping over 6 in hurdles | 8x10 feet
- Single leg stance on Airex | 3x30 seconds; bilaterally
- Single leg 6 inch step up with single leg hold | 2x15, 3 second hold; bilaterally

Electrical Stimulation

- IFC with cryotherapy (ice pack) legs elevated | 15 minutes

Week 7 and 8

Aquatic Therapy

- Walking	4x25 feet laps
- Backwards walking	4x25 feet laps
- Side stepping	2x25 feet laps; bilaterally
- Carioca/grapevine	2x25 feet laps; bilaterally
- Standing 3 way hip (flexion, abduction, extension)	1x20; bilaterally
- Single leg press [down] with pool noodle	1x20; bilaterally
- Single leg 6 inch step ups	1x20; bilaterally
- Aqua squats	2x20
- Standing marches	2x20
- Standing hip circles; clockwise/counterclockwise	2x20; bilaterally
- Kickboard push and pulls	2x20
- Kickboard push downs	2x20
- Kickboard side to side	2x20
- Deep water bicycling with noodle	10 to 15 minutes

REFERENCES

1. Hsu H. Knee osteoarthritis. *StatPearls [Internet].*, U.S. National Library of Medicine, 29 Sept 2019, www.ncbi.nlm.nih.gov/books/NBK507884/.

2. User SHS. The AJRR 2018 Annual Report: THA/TKA Surgical Insights Summary and Beyond. The AJRR 2018 Annual Report: THA/TKA Surgical Insights Summary and Beyond. http://blog.ajrr.net/the-ajrr-2018-annual-report-tha-tka-surgical-insights-summary-and-beyond.

3. Pua Y-H, Poon CL-L, Seah FJ-T, et al. Predicting individual knee range of motion, knee pain, and walking limitation outcomes following total knee arthroplasty. *Acta Orthop.* 2019;90(2):179-186. doi:10.1080/17453674.2018.1560647.

4. Benedetti M, Catani F, Bilotta T, Marcacci M, Mariani E, Giannini S. Muscle activation pattern and gait biomechanics after total knee replacement. *Clin Biomech.* 2003;18(9):871-876. doi:10.1016/s0268-0033(03)00146-3.

5. Jarit GJ, Mohr KJ, Waller R, Glousman RE. The effects of home interferential therapy on post-operative pain, edema, and range of motion of the knee. *Clin J Sport Med.* 2003;13(1):16-20. doi:10.1097/00042752-200301000-00004.

6. Magee DJ, Zachazewski JE, Quillen WS, Manske RC. *Pathology and Intervention in Musculoskeletal Rehabilitation.* Maryland Heights, MO: Saunders/Elsevier; 2016.

7. Westby MD, Brittain A, Backman CL. Expert consensus on best practices for post-acute rehabilitation after total hip and knee arthroplasty: a Canada and United States delphi study. *Arthritis Care Res.* 2014;66(3):411-423. doi:10.1002/acr.22164.

8. Single leg stance or "One-legged stance test". Shirley Ryan AbilityLab. https://www.sralab.org/rehabilitation-measures/single-leg-stance-or-one-legged-stance-test. Accessed April 23, 2020.

9. Collins N, Prinsen C, Christensen R, Bartels E, Terwee C, Roos E. Knee injury and osteoarthritis outcome score (KOOS): systematic review and meta-analysis of measurement properties. *Osteoarthritis Cartilage.* 2016;24(8):1317-1329. doi:10.1016/j.joca.2016.03.010.

10. Roos, E.M., Toksvig-Larsen, S. Knee injury and osteoarthritis outcome score (KOOS) – validation and comparison to the WOMAC in total knee replacement. *Health Qual Life Outcomes.* 2003;1(17). https://doi.org/10.1186/1477-7525-1-17

11. Knee injury and Osteoarthritis Outcome Score, Ewa Roos. Knee injury and Osteoarthritis Outcome Score, Ewa Roos. http://www.koos.nu/.

12. Deborah M Kennedy, Paul W Stratford, Daniel L Riddle, Steven E Hanna, Jeffrey D Gollish, Assessing recovery and establishing prognosis following total knee arthroplasty. *Phys Ther.* 2008;88(1):22-32. https://doi.org/10.2522/ptj.20070051

13. Bade MJ, Kohrt WM, Stevens-Lapsley JE. Outcomes before and after total knee arthroplasty compared to healthy adults. *J Orthop Sports Phys Ther.* 2010;40(9):559-567. doi:10.2519/jospt.2010.3317

14. Mizner RL, Petterson SC, Snyder-Mackler L. Quadriceps strength and the time course of functional recovery after total knee arthroplasty. *J Orthop Sports Phys Ther.* 2005;35(7):424-436. doi:10.2519/jospt.2005.35.7.424

15. Harikesavan K, Chakravarty RD, Maiya AG, Hegde SP, Y Shivanna S. Hip abductor strengthening improves physical function following total knee replacement: one-year follow-up of a randomized pilot study. *Open Rheumatol J.* 2017;11:30-42. Published 2017 Mar 31. doi:10.2174/1874312901711010030

16. Alnahdi AH, Zeni JA, Snyder-Mackler L. Hip abductor strength reliability and association with physical function after unilateral total knee arthroplasty: a cross-sectional study. *Phys Ther.* 2014;94(8):1154-1162. doi:10.2522/ptj.20130335

17. Piva SR, Teixeira PE, Almeida GJ, et al. Contribution of hip abductor strength to physical function in patients with total knee arthroplasty. *Phys Ther.* 2011;91(2):225-233. doi:10.2522/ptj.20100122

18. Liao C-D, Liou T-H, Huang Y-Y, Huang Y-C. Effects of balance training on functional outcome after total knee replacement in patients with knee osteoarthritis: a randomized controlled trial. *Clin Rehabil.* 2013;27(8):697-709. doi:10.1177/0269215513476722.

19. Lu M, Su Y, Zhang Y, et al. Effectiveness of aquatic exercise for treatment of knee osteoarthritis. *Z Rheumatol.* 2015;74(6):543-552. doi:10.1007/s00393-014-1559-9

20. Wright Physical Therapy. *Knee Extension After A Total Knee Arthroplasty (TKA).* Wright Physical Therapy. https://www.wrightpt.com/knee-extension-after-a-total-knee-arthroplasty-tka/. Accessed May 28, 2020.

21. Boonstra MC, Schwering PJ, De Waal Malefijt MC, Verdonschot N. Sit-to-stand movement as a performance-based measure for patients with total knee arthroplasty. *Phys Ther*. 2010;90(2):149-156. doi:10.2522/ptj.20090119

22. Wang T-J, Belza B, Thompson FE, Whitney JD, Bennett K. Effects of aquatic exercise on flexibility, strength and aerobic fitness in adults with osteoarthritis of the hip or knee. *J Adv Nurs*. 2007;57(2):141-152. doi:10.1111/j.1365-2648.2006.04102.x

23. Park S-K, Kim J-H. Effects of EMG-biofeedback training on total knee replacement patients' lower extremity muscle activity and balance. *J Exerc Rehabil*. 2013;25(2):81-87.

24. Shanb A-SA, Youssef EF. Effects of adding biofeedback training to active exercises after total knee arthroplasty. *J Musculoskelet Res*. 2014;17(01):1450001. doi:10.1142/s0218957714500018

25. Stevens-Lapsley JE, Balter JE, Wolfe P, Eckhoff DG, Kohrt WM. Early neuromuscular electrical stimulation to improve quadriceps muscle strength after total knee arthroplasty: a randomized controlled trial. *Phys Ther*. 2012;92(2):210-226. doi:10.2522/ptj.20110124

26. Donec V, Kriščiūnas A. The effectiveness of Kinesio Taping® after total knee replacement in early postoperative rehabilitation period: a randomized controlled trial. *Eur J Phys Rehabil Med*. 2014;50(4):363-371.

27. Using Therapeutic Exercise in Rehabilitation. In: Prentice WE, ed. *Principles of Athletic Training: A Guide to Evidence-Based Clinical Practice, 16th ed.* New York, NY: McGraw-Hill;2016. http://accessphysiotherapy.mhmedical.com.ezproxylr.med.und.edu/content.aspx?bookid=2429&sectionid=189098783.

28. Skou S, Roos E, Laursen M, et al. Total knee replacement and non-surgical treatment of knee osteoarthritis: 2-year outcome from two parallel randomized controlled trials. *Osteoarthritis Cartilage*. 2018;26(9):1170-1180. doi:10.1016/j.joca.2018.04.014

29. Ciolac EG, Silva JM, Greve JM. Effects of resistance training in older women with knee osteoarthritis and total knee arthroplasty. *Clinics (Sao Paulo)*. 2015;70(1):7-13. doi:10.6061/clinics/2015(01)02

30. Bade MJ, Stevens-Lapsley JE. Early high-intensity rehabilitation following total knee arthroplasty improves outcomes. *J Orthop Sports Phys Ther*. 2011;41 (12):932-941. doi: 10.2519/jospt.2011.3734.

31. Canovas F, Dagneaux L. Quality of life after total knee arthroplasty. *Orthop Traumatol Surg Res*. 2018;104(1S):S41-S46. doi:10.1016/j.otsr.2017.04.017